STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX AJ

PERFORMANCE AUDIT PROCEDURES FOR DIOXIN PUF SAMPLERS

MONITORING AND LABORATORY DIVISION

APRIL 2003

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AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES
FOR
AIR QUALITY MONITORING

APPENDIX AJ.1

PERFORMANCE AUDIT PROCEDURES
FOR
DIOXIN PUF SAMPLERS

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MONITORING AND LABORATORY DIVISION

APRIL 2003

AJ.1.0 INTRODUCTION

AJ.1.0.1 GENERAL AUDITING PROCEDURES

The primary goal of an auditing program is to identify system errors that may result in suspect or invalid data. The absolute efficiency of the monitoring system (labor input versus valid data output) is contingent upon effective quality assurance procedures.

This true assessment of the accuracy and efficiency of the Andersen Polyurethane Foam (PUF) dioxin/furan/dioxin-like polychlorinated biphenyls (PCB) measurement system can only be achieved by conducting an audit under the following guidelines:

A. Without special preparation or adjustment of the system to be audited.

B. By an individual with a thorough knowledge of the instrument or the process that is being evaluated, but not by the routine operator.

C. With accurate calibrated National Institute of Standards Technology (NIST) traceable transfer standards that are completely independent of those used in routine calibration.

D. With complete documentation of audit data for submission to the operating agency. Audit information includes, but is not limited to, types of instruments and audit transfer standards, model and serial numbers, transfer standard traceability, calibration information, and collected audit data.

An independent observer should be present, preferably the routine operator of the sampling equipment. This practice not only contributes to the integrity of the audit, but also allows the operator to offer any explanations and information that will help the auditor to determine the cause of discrepancies between measured audit data and the sampling equipment response.

AJ.1.0.2 FLOW RATE AUDITING PROCEDURES

Audit procedures provided here are specific to Andersen PUF samplers that require a flow rate of 0.24 cubic meters per minute (m^3/min) at standard conditions (25°C and 760 mm Hg). Audit techniques may vary among different models of samplers because of differences in required flow rates, flow controlling devices, options utilized (i.e., continuous flow recorder), and the configuration of the sampler. In this subsection, the following conditions are assumed:

A. The sampler flow rate, at the sampler inlet, is designed to operate at 0.24 m^3/min or 240 standard liters per minute (slpm) under standard conditions.

B. The calibrated transfer standard will be a Thermo Andersen G40-LP fixed orifice equipped with a Dwyer Slack-tube manometer or digital manometer. This equipment is NIST traceable and certified once a quarter with the standard deviation within 1.0% of the last two certifications.

C. The audit orifice calibration relationship is expressed in terms of the standard (true) flow rate (Qstd) versus the manometer pressure drop (ΔP), these units being slpm versus inches of water ("H_2O).

D. The type of sampler used for particulate and gas phase dioxin and dioxin-like compound measurement is provided in Figure AJ.1.2.1

AJ.1.1 AUDIT EQUIPMENT

Performance audits of Thermo Andersen PUF Sampler-Special requires the following equipment:

A. A calibrated (NIST traceable) Thermo Andersen G40 orifice device with the most recent calibration report.

B. A differential pressure gauge (manometer) with a range of 0-30" of H_2O and a minimal scale division of at least 0.2 inches (slack tube or digital).

C. A thermometer capable of accurately measuring temperature in the range of -20°C to +60°C and accurate to the nearest 1°C. It must be referenced to a NIST or ASTM thermometer and be checked annually. The thermometer should be within ±2°C on the annual check.

D. A barometer capable of accurately measuring ambient pressures to the nearest millimeter of mercury (mm Hg) in the range of 500 to 800 mm Hg. The barometer must be referenced within ±5 mm Hg of a barometer traceable to NIST at least annually.

E. Quality Assurance Audit Dioxin Worksheet (Figure AJ.1.2.2).

F. Spare PUF-XAD-PUF cartridges, clean filters, and miscellaneous hand tools.

NOTE: The site operator is responsible for providing the sampler's calibration relationship (calibration curve or factor) for the subsequent determination of the sampler's standard flow rate (Qind).

AJ.1.2 AUDIT PROCEDURES

When conducting an audit of the Thermo Andersen PUF Sampler-Special, the following procedures should be adhered to:

A. Remove the filter holder assembly from the sample head. If a sample QFF and/or PUF-XAD-PUF cartridge are in place, have the site operator remove the sample media during the audit. Care should be taken when handing sample media as not to compromise the integrity of the sample (i.e. wearing non-powdered latex gloves and proper storage during audit).

B. Install dummy PUF-XAD-PUF cartridge and a dummy QFF and teflon rings into the sampler. The PUF-XAD-PUF cartridge should be loaded into the sampling head with the screen towards the bottom. The cartridge should have an o-ring in the groove near the open end of the cartridge; if the o-ring is missing, one should be installed. Reattach the filter holder assembly to the sampling head. Loosen the three thumbscrews on the top of the filter assembly and remove the protective plate and retaining rings. Use forceps to place the teflon gasket onto the filter support screen. Place a clean QFF over the lower teflon gasket; however, do not install the upper teflon filter holder retaining ring. Attach the audit orifice to the filter holder assembly. Attach the stack tube manometer or digital manometer to the tap on the audit orifice and check that the tubing connectors on the manometer are open. Do not restrict the flow rate through the orifice (i.e. by using plates or closing the valve). Use an unrestricted orifice. Simultaneously tighten the thumbscrews on the top of the filter assembly on alternate corners to prohibit leaks and to assure even tightening. The fittings should be hand-tightened; too much compression can damage the sealing gasket. Make sure the audit orifice gasket is present and the orifice is not cross-threaded on the faceplate.

C. Inspect the differential pressure gauge for the correct zero and adjust if necessary.

D. Switch on the sampler and allow it to warm up to operating for 15 minutes.

E. Observe and record the following parameters on the Quality Assurance Audit Worksheet Dioxin PUF Sampler – Special (Figure AJ.1.2.2):

1. Site name, site number and date.

2. Site address and agency.

3. Technician and auditors.

4. Sampler make, model and ID number.

5. Sampler designation - NAMS, SLAMS, OTHER etc.

6. Last calibration date and Magnahelic reading.

7. EPA equivalency number.

8. Cal Equip. Cert. Date, calibration Slope and Intercept.

9. Barometric pressure (Pa) in mm Hg. and Ambient temperature (Ta) in degrees Centigrade (°C).

F. When the sampler has warmed up to operating temperature, read the pressure deflection across the orifice by reading the differential pressure gauge and record as ΔP on the audit worksheet.

H. Record the sampler's magnehelic reading on the audit worksheet.

I. Repeat Steps F and H, of AJ.1.2, two more times to give you a total of three observations that are approximately five minutes apart. **DO NOT TURN SAMPLER OFF BETWEEN READINGS.**

J. LEAK CHECK: After the flow rate audit, a leak check should be conducted. The leak check should be performed without any sampling media installed in the sampler. The following procedures should be followed:

1. Remove the dummy PUF cartridge and dummy QFF, if necessary.

2. Screw on the sampling head and place a teflon filter on top.

3. Place the filter holder and cover plate over the inlet opening and secure with the thumbscrews.

4. Energize the sampler. A leak-free system will also indicate no response on the magnehelic. Leaks are usually caused by either a missing gasket at the junction of the orifice and sampling head or loose thumbscrews.

5. Turn off the sampler and remove the cover plate. **Do not run the sampler longer than 30 seconds with a plugged calibration orifice or the motor will overheat and cause damage to the motor.**

6. Record the results of the leak check on the Quality Assurance Audit Worksheet Dioxin PUF Sampler – Special (Figure AJ.1.2.2).

NOTE: In the event the sampler does not pass the leak tests notify the technician of equipment failure and document any needed information. Trouble shoot as necessary.

K. Gather all audit data, including the audit orifice calibration information, the Thermo Andersen PUF Sampler-Special's calibration data (calibration curve), and the recorder chart that graphically displays the sampler response.

L. Verify the correct calibrator and sampler recorder responses have been written on the worksheet.

M. Ask the operator to calculate the sampler's standard flow rate (Qind) as determined by the calibration relationship and record on the worksheet.

N. Determine the standard flow rate through the audit transfer standard orifice using Equation 1.

$$Qstd = (m * (\Delta P * Pa / Ta)^{1/2} + b) * 28.32 \quad \text{(Eq. 1)}$$

Where:

Qstd = standard flow rate as indicated by the audit orifice, m^3/min. (slpm)
m = slope of the orifice.
$\Delta P(H_2O)$ = pressure change across the orifice, in inches of water H_2O.
Ta = ambient temperature in Kelvin.
Pa = ambient pressure in mm Hg.
b = intercept of the orifice.
28.32 = conversion factor from SCFM to SLPM

O. Determine the percent difference between the sampler actual flow rate (Qind) and the corresponding audit measured true flow rate using Equation 2:

$$\% \text{ Difference} = \frac{[Qind - Qstd]}{Qstd} \times 100 \quad \text{(Eq.2)}$$

P. Verify the standard flow rate determined by the audit orifice is within ±10% of the specified standard flow rate of the sampler. If the true flow rate is outside the specified criteria, the Quality Assurance Section will make a recommendation to investigate data validity. Upon investigation, the release, invalidation, or correction of all data from the last calibration forward or known date of change (to be determined by the reporting agency) may result.

Q. Generate an audit report by entering the responses recorded into the database program (Figure AJ.1.2.3).

Figure AJ.1.2.1
Thermo Andersen PUF Sampler - Special

QA AUDIT WORKSHEET
DIOXIN PUF SAMPLER - SPECIAL

Site Name: ____________________ Site #:__________ Date: __________

Address: ____________________ Agency: ____________________

Technician: ____________________ Auditors: ____________________

Model: ____________________ ID#: __________ NAMS[ ] SLAMS[ ] PAMS[ ] SPM[ ]

Station Instrument Flow Rate			
Run 1	Run 2	Run 3	Average

Audit Orifice DeltaP			
Run 1	Run 2	Run 3	Average

Cal. Date:__________ Magnehelic Reading: __________ EPA Equiv. Number: __________ Collocated Yes[ ] No[ ] Pass Leak Test Yes[ ] No[ ]

Cal. Equip. Cert Date: __________ Slope: ______ Intercept: ______ Baro: ______ Temp: _____ °C

Model: ____________________ ID#: __________ NAMS[ ] SLAMS[ ] PAMS[ ] SPM[ ]

Station Instrument Flow Rate			
Run 1	Run 2	Run 3	Average

Audit Orifice DeltaP			
Run 1	Run 2	Run 3	Average

Cal. Date: __________ Magnehelic Reading: __________ EPA Equiv. Number: __________ Collocated Yes[ ] No[ ] Pass Leak Test Yes[ ] No[ ]

Cal. Equip. Cert Date: __________ Slope: ______ Intercept: ______ Baro: ______ Temp: _____ °C

Model: ____________________ ID#: __________ NAMS[ ] SLAMS[ ] PAMS[ ] SPM[ ]

Station Instrument Flow Rate			
Run 1	Run 2	Run 3	Average

Audit Orifice DeltaP			
Run 1	Run 2	Run 3	Average

Cal. Date: __________ Magnehelic Reading: __________ EPA Equiv. Number: __________ Collocated Yes[ ] No[ ] Pass Leak Test Yes[ ] No[ ]

Cal. Equip. Cert Date: __________ Slope: ______ Intercept: ______ Baro: ______ Temp: _____ °C

Air Resources Board
Quality Assurance Section

QA-DIOXIN
Revised 04/03

Figure AJ.1.2.2
QA Audit Worksheet Dioxin PUF Sampler - Special

Technical Appendix - Dioxin PUF Sampler - Special

Station/Van Audit Data & Results

Van Data	Station Data				
Pressure Drop (inches H2O)	Inicated Flow (slpm)	Standard Flow (slpm)	Average Inicated Flow (slpm)	Average Standard Flow (slpm)	Percent Difference
4.30	240	235			
4.33	240	235	240	236	1.8%
4.40	240	237			

Audit Calculations

Standard Flow = (2.4 * Squareroot (Pressure Drop * Ambient Pressure / Ambient Temperature) + intercept) * 28.32

slope = 2.4 intercept = 0.235

Ambient Pressure in mm Hg = 755 Ambient Temperature in Kelvin = 288.45

Instrument/AIRS Information

ARB Number	70074	AIRS Number	6071201
Audit Date	4/30/2003	Instrument Manf.	Thermo Andersen
Version	0	Model	PUF
Quarter	2	Serial Number	34567
Van	E	Last Calibration	4/29/2003

General Comments

Sample Audit Report

California Air Resources Board
Monitoring and Laboratory Division
Quality Assurance Section

Figure AJ.1.2.3
QA Audit Dioxin PUF Sampler - Special Report

D.1.3 AUDIT DATA REPORTING

The operating agency should be given a copy of the audit results when the audit is completed. If a sampler exhibits unsatisfactory agreement with the audit results (audit differences exceed ARB's control limits), the operating agency needs to be informed and an investigation must begin as soon as possible to validate data.